INFORMATION BULLETIN 3

U.S. BUREAU OF RECLAMATION

A Status Report on

THE SAN LUIS UNIT SPECIAL STUDY

U.S. Bureau of Reclamation
San Luis Unit
Central Valley Project
California

August 1984

THE SAN LUIS UNIT SPECIAL STUDY--AN OVERVIEW

In 1960, Congress authorized construction of the San Luis Unit of the Central Valley Project. The San Luis Unit was designed to supply water and also to provide an agricultural drain to dispose of subsurface drainage for the lands within the unit. The Bureau of Reclamation completed part of the drain and the first stage of Kesterson Reservoir, but construction was stopped in 1975 when project funds ran out. The present drain serves only 8,000 acres and terminates at Kesterson Reservoir, which was planned as a regulating reservoir but is now used as evaporation ponds. The Bureau is now conducting the San Luis Unit Special Study to define a plan to complete drainage facilities for the unit and the adjoining Delta-Mendota Canal service area.

Both the State and Federal governments have recognized the need for a drainage and salt management program in the San Joaquin Valley for many years. Various drainage alternatives were evaluated between 1975 and 1978 by the Interagency Drainage Program (IDP), a joint study conducted by the California Department of Water Resources, the State Water Resources Control Board, and the Bureau. The IDP report concluded that the export of salts from the valley through a master drain for disposal in the western Delta estuary was the most economical and environmentally acceptable solution.

Following the IDP report, the Bureau began proceedings to obtain a permit from the State Water Resources Control Board to discharge drainage to the estuary near Chipps Island. In 1981, the board established conditions for obtaining a discharge permit, and the Bureau began a three-year study to satisfy the board's information requirements. The Bureau cannot finally determine the feasibility of a drain discharging to the estuary or of any other alternative until the State board actually sets the discharge requirements it finds necessary to protect water quality. The Bureau will soon request requirements for permits for the other alternatives being examined.

Most of the technical studies required by the State board had been completed when the high levels of selenium were discovered at Kesterson Reservoir and suspected of causing high mortality rates and deformities observed in bird chicks and embryos at the reservoir. Kesterson Reservoir consists of ponds used to evaporate drainage water, and the selenium has become concentrated there. Following the findings at Kesterson, it became obvious that additional studies were needed to determine where the selenium originated and to see if it was widespread in the drainage water or found only in certain areas. Studies were also needed to answer many questions about the various forms selenium takes, and its effects on living things. These studies will determine not only what levels of selenium are safe, but also possible methods of removing selenium from the drainage water.

At the time the selenium concerns arose, the Bureau had narrowed down the alternatives considered in the special study to the three considered most practical in the IDP report: (1) Completion of the San Luis Drain with discharge to the estuary near Chipps Island, (2) in-valley evaporation, and (3) desalting. The alternative of no action was also being assessed for purposes of comparison with the others. Now that the Bureau has extended the study to address the alternatives in light of the information on selenium, the study will also reconsider various other alternatives previously eliminated because of very high costs, environmental problems, or institutional constraints.

There is no natural salt sink, like the ocean or the Salton Sea, in the valley, so most practical solutions being considered involve transporting the salt or drainage outside the immediate area. The most environmentally acceptable solution will require support from not only valley residents, but also residents in any area where drainage may be disposed. To find a solution to this important problem, it will be essential to enlist the involvement and active participation of concerned citizens throughout the State as the options are explored.

At the conclusion of the study, the Bureau will present the results in a Special Report and Draft Supplement to the Final Environmental Statement for the San Luis Unit of the Central Valley Project in California. The report will evaluate the expanded number of alternatives to the agricultural drainage and salt management problems in the study area and outline the environmental effects of all the alternatives evaluated. The Bureau expects it may take about three years to complete the expanded study.

Dear Californian,

This is the third in a series of bulletins prepared to provide information about salt management issues affecting agriculture in the San Joaquin Valley. Salt buildup in the soils is seriously affecting farmlands on the west side of the valley. Present drainage methods are degrading the water quality of the San Joaquin River and large areas of wetlands habitat for the valley's waterfowl and fishery resources.

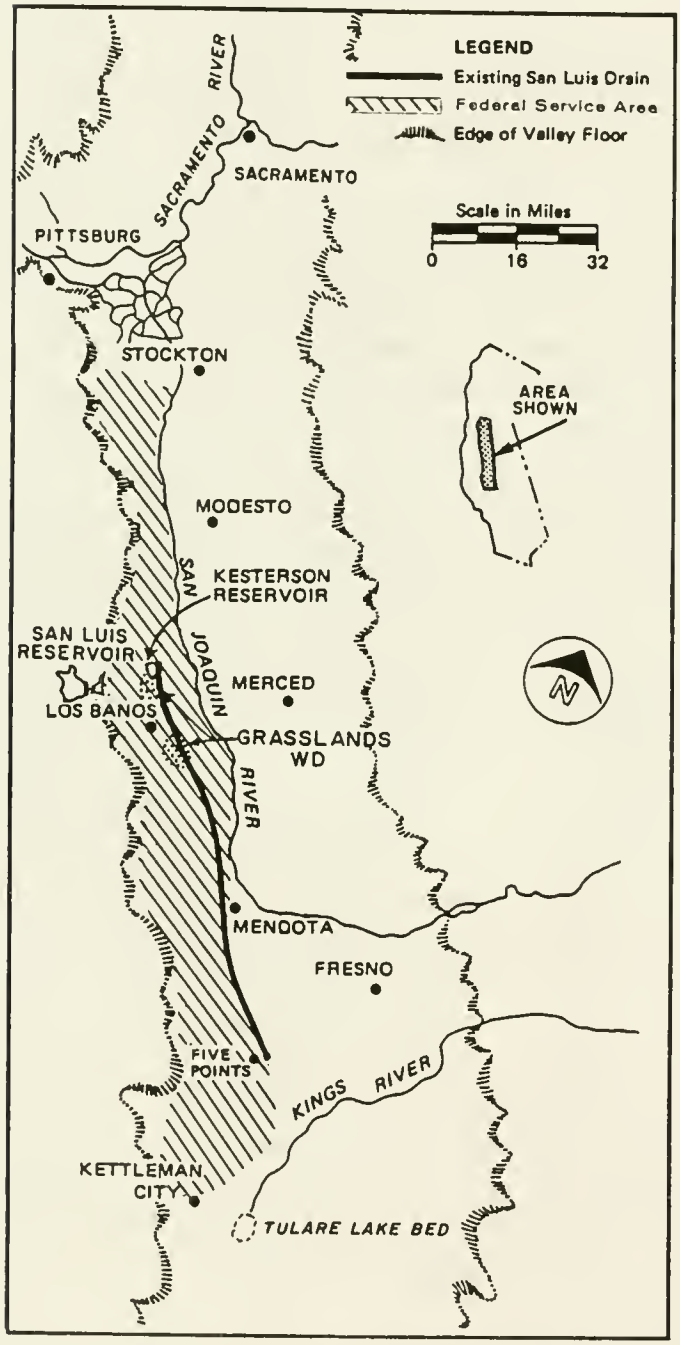
This bulletin is a status report on the U.S. Bureau of Reclamation's efforts to correct these problems. The Bureau is seeking a solution for the problem area served by the Federal Central Valley Project (CVP). This area includes about 500,000 affected acres, between the Sacramento-San Joaquin Delta and Kettleman City. These lands are in the San Luis Unit and Delta-Mendota Canal service areas of the CVP.

Information presented in this bulletin covers:

- Problems occurring now from lack of adequate drainage disposal facilities,
- A new approach to the San Luis Unit Special Study to solve these problems,
- Goals of the study,
- Alternatives being considered to provide safe drainage and salt disposal,
- Work completed and under way, and
- Status of Kesterson Reservoir.

The first two bulletins in this series were published in January and February 1984. They discussed the alternative solutions then being considered and the selenium problem at Kesterson Reservoir. The magnitude of the selenium problem and awareness of the need for treatment or removal of selenium in the region have caused the Bureau to reevaluate some alternatives previously rejected, and also to consider other possible solutions. The Bureau has extended its special study to allow time to fully explore the alternatives and to enlist public participation in the decisions to be made.

The Bureau will hold meetings and workshops periodically during the study to discuss alternatives, to present study results, and to discuss specific issues and concerns. Other information bulletins will also be prepared throughout the study. You will receive meeting notices and future bulletins if you are on the mailing list for this bulletin. Please use the enclosed coupon or write to us at the address shown on the coupon to let us know of other individuals interested in receiving this information and to send us your comments.



DRAINAGE PROBLEM AREA

THE PROBLEM--WHAT IS HAPPENING NOW

The San Joaquin Valley is one of California's major agricultural centers. The economy of the region is based on agriculture, and the valley helps to make the state the largest producer of table foods in the world. The west side of the San Joaquin Valley has serious drainage and salt management problems that are causing the area's farm production to decrease. Unless these problems are solved, the affected land will eventually become too saline to be farmed productively.

Profitable irrigated agriculture requires a favorable balance in the soil among moisture, oxygen, nutrients, and salt concentration. Soils of most of the San Joaquin Valley are naturally high in salt concentration. Irrigation water also contains salts. To achieve the favorable balance needed, farmers must remove excess moisture and salts from the root zone. On the west side of the San Joaquin Valley there is an impermeable clay layer from 10 to 40 feet below the surface which restricts the downward flow of salty water. The water perches above the clay layer and, with continued irrigation, rises toward the surface. Crop productivity begins to decline as perched water rises to the root zone. At first, farmers must select more salt-tolerant crops. Ultimately, salt concentrations reach such high levels that farmers can no longer grow profitable crops.

Farmers can correct the problem of salt accumulation and perched water tables by installing subsurface drainage systems to carry the saline water away. The drainage-related environmental problems that are now occurring on the west side of the valley result from the lack of an acceptable way to dispose of this subsurface drainage water.

A total of about 251,000 acres is now affected--either by inadequate drainage of salts and leaching water or because the drainage water being disposed is adversely affecting valley lands and the San Joaquin River. Drainage water from about 77,000 acres north of Mendota--about one-third of this land--is discharged by water districts into the San Joaquin River, the valley's only natural outlet. Drainage from about 8,000 acres west of Mendota is discharged into Kesterson Reservoir by way of the San Luis Drain. Lands totaling about 166,000 acres needing drainage now have no place to dispose of their drainage water. The land needing drainage is expected to increase to 381,000 acres by the year 2020 and 495,000 acres by 2095, or about 40 percent of the land within the service areas.

The discovery of high levels of selenium in the drainage water stored at Kesterson Reservoir has raised concerns about all the present methods of drainage disposal. This trace element occurs naturally in the soil and is believed to be the cause of high mortality rates and deformities observed in waterfowl at Kesterson Reservoir. Drainage water containing selenium enters the reservoir by way of the existing drain.

Kesterson Reservoir is not the only recipient of drainage containing selenium. Drainage from lands believed to have relatively high selenium levels is also discharged directly into the San Joaquin River. Some is discharged indirectly into the river by way of wetlands in Grasslands Water District, which uses drainage water for both irrigation and waterfowl habitat management. Some drainage is stored on individual farms in small, unlined evaporation ponds, and high concentrations of selenium in these ponds could be a danger to the ground water and to waterfowl.

The selenium problems have intensified the urgency for developing a drainage and salt management program that will adequately protect the environment. Without development of drainage facilities, drainage--including the selenium it contains--will continue to be a problem. Farmers whose lands contain high selenium levels will continue to irrigate their lands, and discharge the drainage directly or indirectly into the San Joaquin River or store it in evaporation ponds unless the State board restricts these practices.

Even if farming is stopped on these lands, drainage-related problems will persist. Irriga-

tion of upslope lands results in higher water levels near the valley trough. This allows drainage water to seep through selenium-affected soils into open channels and ultimately reach Fresno Slough and other tributaries to the San Joaquin River. A collection and disposal system for the subsurface drainage could prevent harmful or toxic constituents in the drainage water from entering surface or ground-water supplies.

Apart from the selenium concern, the overall quality of San Joaquin River water is deteriorating because of the discharge of drainage from west-side lands and reduced freshwater flows from tributary east-side streams. Salinity levels in the river are as much as twice as high as they would be without drainage discharge. The discharges also contain boron and trace elements other than selenium. A method for disposing of subsurface drainage is needed which will protect the river's beneficial uses for irrigation, municipal and industrial use, and fishery and wildlife habitats.

In the absence of a long-term solution to the drainage problem, irrigated crops will become increasingly threatened by both drainage and salt disposal problems. As agricultural productivity is reduced, farming will become increasingly uneconomical. As lands go out of production and farms go out of business, service industries and the local tax base will decline, unemployment will rise, and some people will have to leave the area to find work. These local effects will in turn be felt in both the regional and state economies, which are closely tied to agriculture.

THE EXPANDED STUDY

In technical studies conducted as part of the San Luis Unit Special Study, the Bureau did not anticipate or adequately recognize the high concentrations of selenium found in subsurface agricultural drainage water. Consequently, alternatives for providing a drainage management program for lands in the San Joaquin Valley must be reformulated. The Bureau is working with other Federal and State agencies and specialists from the private sector to determine what additional information is needed and the best way to obtain it. The steps required to ultimately select the best solution to the drainage problems are:

1. Define the goals and objectives of a drainage management program;

2. Identify the critical issues; that is, the obstacles to meeting the goals and objectives;

3. Verify the adequacy of existing data, identify and collect needed additional data, and reevaluate future conditions;

4. Formulate new alternatives to meet the goals and objectives;

5. Evaluate alternatives to find out which ones best meet the goals and objectives; and

6. Recommend a plan of action.

Participation in the study by a broad range of agencies, groups, and individual citizens is needed to ensure that all reasonable alternatives are considered so that the best solution possible can be obtained. The Bureau will hold workshops and public meetings regularly to discuss the alternatives to be evaluated, the study's progress, and the results of the alternatives evaluation. Information bulletins will discuss specific issues and studies in detail and present study results.

One of the first steps in the extended study is to verify the accuracy of the data already collected. In particular, information on the chemical quality of drainage water is being reviewed, since discrepant results were found in tests for selenium. Following is a summary of the events that led to the decision to reestablish baseline data for selenium and other trace elements.

1. Test results of water samples collected by the Bureau in 1981 showed relatively high levels of selenium in the San Luis Drain and in the Panoche Fan, an alluvial fan encompassing about 220,000 acres along the west side of the San Joaquin Valley west of Mendota. The Bureau provided these results to the U.S. Fish and Wildlife Service (FWS), which became concerned that the high concentrations of selenium could be harmful to fish and wildlife.

2. The FWS collected water and fish samples from the drain in July 1982 and analyzed them the following October. FWS reported the results to the Bureau in December 1982 and suggested that additional work was needed to determine the impact of high selenium concentrations on waterfowl.

3. In May 1983, the FWS began field studies to find out what effect high concentrations of selenium could have on the reproductive success of waterfowl utilizing Kesterson Reservoir. Field observations made by the FWS showed very high incidences of mortality and deformities at the reservoir among newborn coots, grebes, stilts, and ducks. The FWS made preliminary results of its survey available in June 1983, and provided additional analysis of the data the following September.

4. Following its findings of bird mortality and abnormalities, the FWS asked the U.S. Geological Survey (GS) to test the drainage water in the San Luis Drain for comparison with the Bureau's results. Both the FWS and GS found higher selenium concentrations than the Bureau had found.

5. In cooperation with the FWS and GS, the Bureau in December 1983 sponsored a conference of scientists to explore available information on selenium, its sources, and its potential effects on waterfowl. At the same time, the Bureau asked the GS to review the Bureau's field techniques and the procedures used by its laboratory contractors to find out why its results were lower than the other agencies'.

6. The GS reviewed the Bureau's field techniques and the procedures and results of the Bureau's laboratory contractors. Several deficiencies were observed, all of which have been corrected. Out of 30 water-quality parameters checked, the most significant deficiency noted involved the difficult and sensitive analytical procedures used in measuring selenium concentrations. The other deficiencies do not seem to have significantly affected the laboratory results.

7. The GS has agreed to supervise the Bureau's laboratory and to certify data produced by it. Until the Bureau can obtain the equipment and people to operate the laboratory in the manner recommended by the GS, the GS'central laboratory in Denver is analyzing trace element samples from the drainage service area.

The State Water Resources Control Board has not yet adopted a water-quality standard for selenium. However, on the basis of its review of the existing scientific literature, the board has recently provided guidelines for safe levels of selenium for freshwater aquatic resources. The board is now reviewing literature on other trace elements to help determine their safe levels for marine and freshwater resources.

In September, Federal and State water pollution control agencies, agencies of the Department of the Interior, and experts familiar with the control of selenium will meet to discuss procedures to be used in establishing water-quality standards and effluent limits for trace elements and the types of additional studies and research that are needed. The results of the studies ultimately made will be used to help determine safe levels of trace elements that potentially could affect drainage disposal areas. The information obtained will be provided to the State board for use in establishing and revising water-quality standards and effluent limits.

The FWS, GS, and the Bureau have established a cooperative program that will direct the study effort to address outstanding technical issues about toxic effects from trace elements such as selenium. The program's purposes are:

1. To define and evaluate all environmentally, economically, and publicly acceptable alternatives for the management of subsurface drainage water;

2. To develop recommendations to reduce or eliminate adverse effects of drainage water on aquatic and estuarine habitats; and

3. To accomplish the above purposes with due recognition of the importance of a drainage solution to agricultural productivity in the San Joaquin Valley.

This program will also present the technical merits of alternative salt disposal methods and treatment to remove toxic substances in drainage water.

Four categories of studies have been identified by the three-agency program: (1) In-valley biology, (2) estuarine biology and biochemistry, (3) geochemistry, and (4) drainage-water treatment. Proposals for some of the studies are being evaluated; other studies have been started or will be started soon. The full study program will be distributed for public review later this year. The studies will describe existing water-quality conditions and forecast conditions expected to occur with continued irrigation. The determination of safe levels of trace elements, including selenium, for fish and wildlife and the development of measures to ensure the protection of these resources will be of utmost importance in these studies.

GOALS OF THE STUDY

To control the existing drainage-related environmental problems in the valley, an effective drainage and salt management program must be developed. If this is not done, individual farmers needing drainage facilities could develop their own evaporation ponds, but wildlife problems similar to those found at Kesterson Reservoir would likely result. If farming were stopped in the area, effects on the economy would be severe. Waterfowl habitat would also be greatly affected if the irrigation supply of drainage water were cut off to Grasslands Water District, reducing already limited wetlands. The water quality of the San Joaquin River is also of serious concern. It is essential to develop a solution to meet all of these needs.

To dispose of agricultural drainage water in any water body used for other purposes, the concentration of nutrients, salts, and dissolved substances such as pesticides and trace elements must be maintained at levels low enough to protect the uses of the water. Any storage facilities and evaporation ponds for the drainage must be managed in a way that will protect both the wildlife that will use them and the underground water supplies.

In this complex setting, the goals of the drainage management program to be evaluated by this study are:

1. To reduce the concentrations of salts and trace elements in the San Joaquin River by intercepting subsurface drainage water now being discharged to the river;

2. To maintain the agricultural productivity of lands on the west side of the valley from Kettleman City north to the Delta by providing drainage disposal for these lands; and

3. To develop a disposal system for the subsurface drainage that will protect the uses and the environmental values of the water and land resources in the valley, the San Francisco Bay-Delta Estuary, and the ocean.

ALTERNATIVES BEING CONSIDERED

For the San Luis Unit Special Study, the Bureau has already evaluated three of the alternatives considered in the IDP. These alternatives--Delta disposal, in-valley evaporation, and desalting--will be reformulated to deal with the higher selenium levels and will be included among the alternatives considered in the expanded study. Other alternatives and combinations of alternatives will also be evaluated to incorporate recent information available on the design and operation of solar ponds and to consider possible treatment for selenium removal, source control, and other means of selenium reduction.

The alternatives identified to date for evaluation (including those discussed above) follow five basic concepts: (1) Land disposal, (2) river discharge, (3) estuarine discharge, (4) ocean discharge, and (5) no action. In-valley evaporation and desalting are included among the land disposal alternatives. Treatment and source control including improved farm management and the use of storage or regulating reservoirs will be considered in connection with all the discharge alternatives. A no-action alternative including consideration of possible management measures will also be evaluated, and will serve as a baseline against which the action alternatives are evaluated.

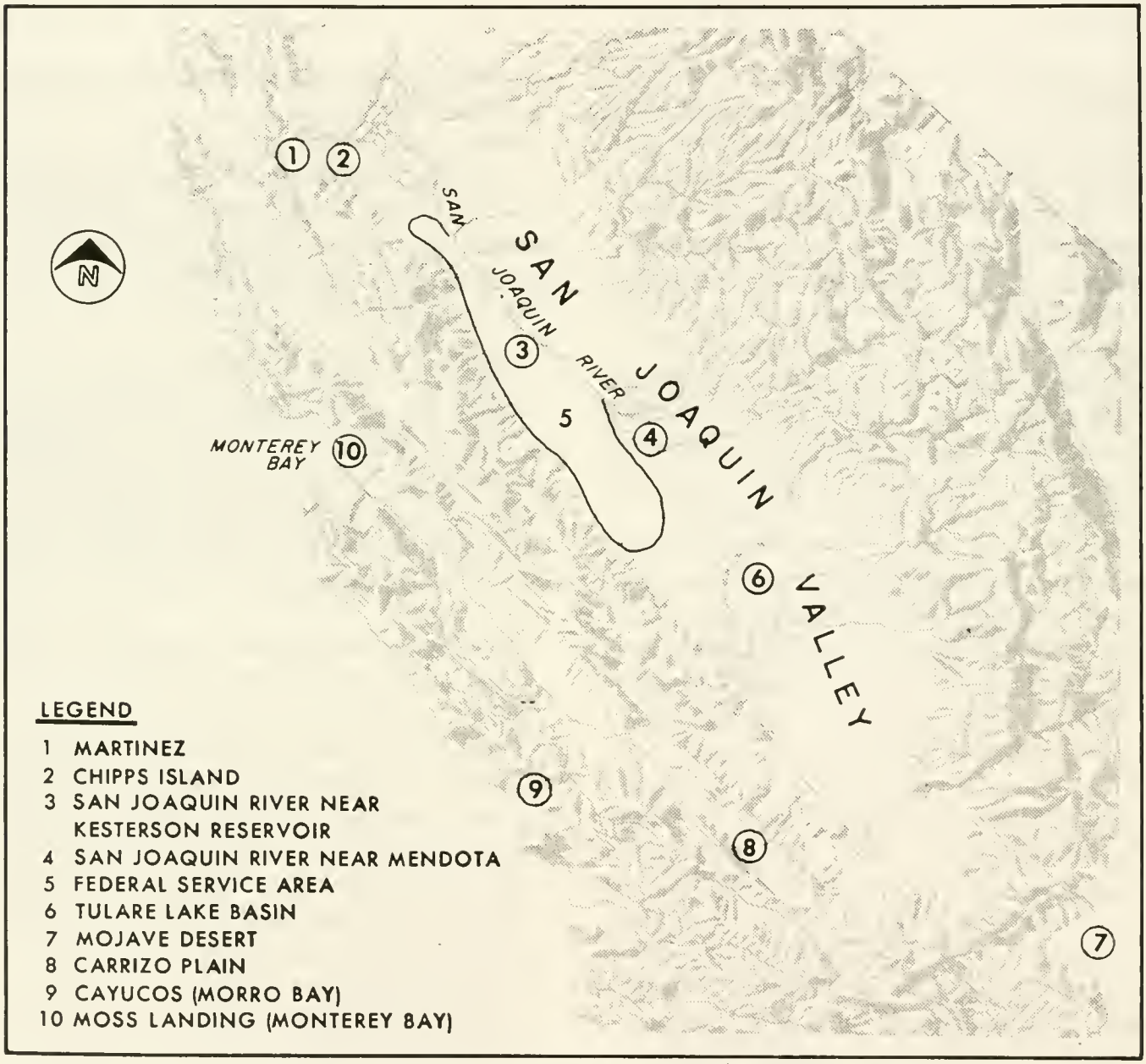
Possible specific alternatives to be considered include the following:

1. Land disposal alternatives including evaporation ponds located in the drainage service area, Tulare Lake drainage basin, Carrizo Plain, or Mojave Desert. Desalting and solar ponds will also be considered.

2. Discharge to the San Joaquin River near Mendota or Kesterson Reservoir. The drainage water could be treated to reduce the concentrations of potentially harmful trace elements, and water from the Delta-Mendota Canal could be used to dilute drainage water discharged to the river.

3. Estuarine discharge at Chipps Island, near Martinez, or other possible sites.

4. At least two ocean discharge sites will be evaluated--Cayucos (Morro Bay) and Moss Landing (Monterey Bay). Both of these ocean discharge sites were considered in the IDP. Section 13953 of the California Water Code prohibits the discharge of a San Joaquin Valley drain into Monterey Bay or tributaries to the bay. Therefore, any proposal for discharge at this site would be contingent upon appropriate changes to the water code by the State legislature.



POSSIBLE DISPOSAL OR DISCHARGE SITES

5. No-action alternative, including various measures by individual landowners and irrigation districts to limit the impact of high ground water and salt buildup in their soils. These measures could include reduced irrigation application and modified irrigation patterns, abandonment of highly saline land, and modification of cropping patterns. These same actions could also be included in any project alternative.

TREATMENT

Specific technology has not yet been developed to remove selenium from agricultural drainage water. Accordingly, it will take considerable work to verify existing techniques that may be applicable or to develop new procedures for removing selenium and other potentially harmful trace elements. The treatment technique selected will be determined in part by effluent limitations ultimately established by the State board. The technical feasibility of meeting the established limits will determine how treatment techniques may be incorporated into the disposal alternatives.

There are four possible treatment techniques being considered: (1) Biological assimilation by algae and grasses, (2) chemical addition and physical removal methods using iron compounds that cause the selenium to settle out, (3) reverse osmosis, or passing water through a semipermeable membrane through which selenium cannot pass, and (4) soil treatment, or attachment of selenium to soil particles. In addition, management alternatives can be used to limit the amount of selenium that would reach a drainage facility. These include retiring certain lands from agricultural production, isolating high-selenium areas from the drainage system, reducing the amount of irrigation water applied to reduce drainage volume, and changing irrigation schedules to minimize selenium concentrations in drainage water.

WORK COMPLETED AND UNDER WAY

Several of the studies necessary to meet the State board's information requirements were recently completed. These studies have provided a broad base of information on which new studies can build.

Federal and State agencies and private contractors working in cooperation with the Bureau have completed studies on salinity and phytoplankton modeling of Suisun Bay and the Delta, trace elements in sediments and benthic organisms in Suisun Bay, macroalgal growth in Suisun and San Pablo Bays, and potentially toxic effects of drainage water on aquatic life in the Bay-Delta Estuary. To supplement completed work, additional studies are being made by the University of California at Davis and the Stanford Research Institute to determine potentially toxic effects of drainage effluent on striped bass and on neomysis (a very small shrimp). Studies on algae and on copepods (small aquatic animals) are also planned. Macroalgal growth and trace element surveys are being continued to evaluate estuarine conditions during 1984. The Bureau, FWS, and GS are preparing study plans to document the movement of trace elements within the estuary and predict the effect of a drain discharge on concentrations within the water column, in sediments, and in animal and plant life.

A survey completed by the University of California at Davis in 1983 has provided information on the application of pesticides, herbicides, fungicides, and amendments to soils in the areas requiring drainage and in adjacent areas. Water samples from the San Luis Drain and Bay-Delta Estuary are being collected for analysis by the Bureau's Engineering and Research Center laboratory in Denver to determine pesticide residues.

The Bureau has begun a review of drainage volume projections to ensure that the drainage facilities considered in all alternatives evaluated are properly sized. For comparison, the GS will also prepare drainage volume estimates for the service area.

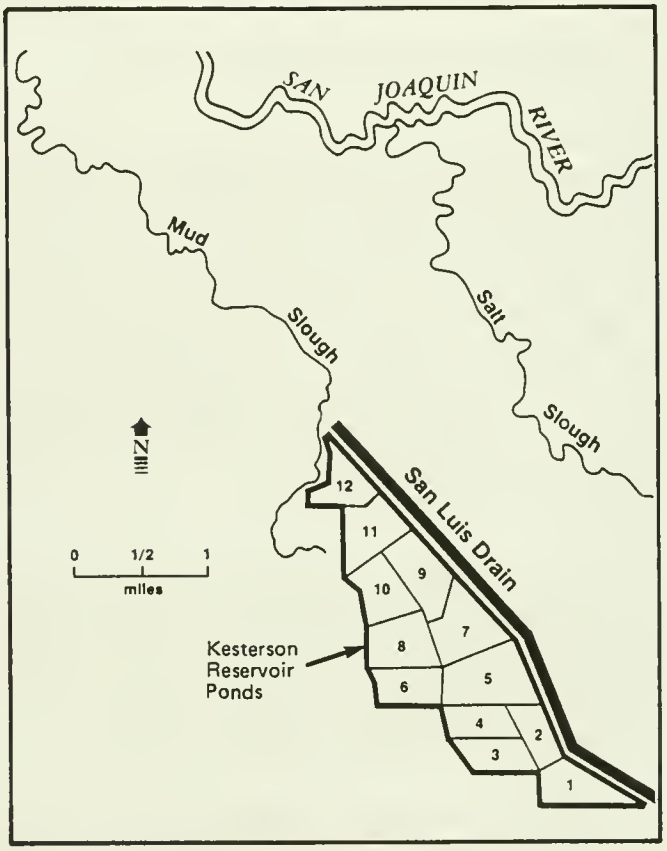
To help determine the distribution of selenium and other trace elements in the valley, the Bureau is collecting data from approximately 60 monitoring sites in the San Luis Unit and Delta-Mendota Canal service areas. Fifty additional sites were recently established near Kesterson Reservoir and 15 near Grasslands Water District.

The GS recently completed a survey of subsurface drainage and shallow ground water at 150 sites in the valley, including the Bureau's monitoring sites. The results of this study will be available this fall and are expected to help locate significant sources of selenium and provide the basis for determining the selenium level in drainage discharge.

STATUS OF KESTERSON RESERVOIR

Kesterson Reservoir continues to be used as a final disposal point for agricultural drainage water from about 8,000 acres. At the same time, the FWS is continuing to monitor waterfowl use of the reservoir and to study the effects of selenium on them.

Several ways to reduce waterfowl exposure to the selenium in the reservoir have been proposed by State and Federal agencies. Plans were made last year to remove vegetation from about half of the reservoir ponds to reduce waterfowl exposure while keeping the remaining ponds in their natural state for study by wildlife biologists. However, because additional open water areas could attract more migratory waterfowl to the reservoir, especially during the winter months, the FWS and the California Department of Fish and Game now have recommended that none of the vegetation be removed.



KESTERSON RESERVOIR

One proposal being considered to reduce waterfowl exposure is hazing, or scaring birds away from Kesterson Reservoir and onto other nearby wetlands. Another possibility is draining the reservoir. However, the drainage water otherwise stored in Kesterson would have to be discharged to the San Joaquin River or evaporation ponds would have to be constructed on nearby farmlands to hold the drainage water. Interim actions to reduce waterfowl exposure and to limit effluent volume and movement are being further examined. As ways to correct deficiencies are identified, they will be implemented wherever practical.

Extensive water-quality and biological monitoring is being done at the reservoir to study the rate of movement and locations of trace elements and their effects on fish and wildlife. It is likely that Kesterson Reservoir will be used extensively for research, including studies on selenium removal and the movement of selenium in sediments and water.

HOW CAN YOU GET INVOLVED?

The Bureau of Reclamation wants to know your views and concerns about the drainage problems in the San Joaquin Valley and alternatives for solving these problems. The Bureau will hold a series of public meetings this fall to discuss the drainage problems, new technical studies being made for the San Luis Unit Special Study, and drainage alternatives being evaluated. We will let you know the meeting schedules.

Other meetings and workshops will be held periodically to present study results and discuss specific issues or concerns and alternatives. Additional bulletins in this series will be prepared for these purposes as well.

Please use the enclosed coupon to let us know of other individuals interested in receiving copies of the information bulletins.

Thank you for taking the time to read this information bulletin. We expect to develop additional bulletins in the near furure which will address specific issues and concerns as an aid to informed public decisions regarding alternative drainage and salt management solutions.

Other bulletins in this series include Information Bulletin 1 on Drainage and Salt Disposal, published in January 1984, and Bulletin 2 on Kesterson Reservoir and Waterfowl, published in February 1984.

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